

# Repair Procedures

The following repair procedures are described:

- Opening the unit
- Power pack
- O2 valve block
- Motor Drive PCB
- Fan
- O2 Diaphragm PCB
- Bypass valve V1
- Expiratory valve V3
- Replacing the EEPROM
- Control PCB
- Pressure measuring unit
- Internal battery



For maintenance procedures according to PMS procedure, see Repair Instructions "Maintenance Procedures".

## Opening the unit

As required, (see also Figure "Front view with front panel and Control PCB folded away" and Figure "Rear view of Savina with rear panel removed" in the "Schematics and Diagrams" section) Savina can be opened at the control unit and/or at the rear panel.

Before opening the unit, observe the following warnings:



**Hazardous voltage. Touching live components can lead to serious injury or death. Before opening the unit, unplug the power plug from the socket-outlet and remove the fuse ([Rear view of the unit, fuse/1](#)).**

- Carefully pry the fuse ([Rear view of the unit, fuse/1](#)) off its holder using a small screwdriver or a similar tool.



**Fig.1** Rear view of the unit, fuse



**Electrostatic discharge may damage electrostatic sensitive devices. When handling electrostatic sensitive devices use a static-dissipative mat and a wrist strap.**

- [Opening the operator control panel](#)
- [Removing the rear panel](#)

## Opening the operator control panel



**Hazardous voltage. Touching live components can lead to serious injury or death. Before opening the unit, unplug the power plug from the socket-outlet and remove the fuse ([Rear view of the unit, fuse/1](#)).**

- Carefully pry the fuse ([Rear view of the unit, fuse/1](#)) off its holder using a small screwdriver or a similar tool.



**Fig.2** Rear view of the unit, fuse



**Electrostatic discharge may damage electrostatic sensitive devices. When handling electrostatic sensitive devices use a static-dissipative mat and a wrist strap.**

- Switch off the device.
- Unplug power plug from socket-outlet.
- Disconnect the O<sub>2</sub> compressed gas supply.
- Slacken the screws ([Opening the operator control panel/1](#)).



**Fig.3** Opening the operator control panel

- Remove the frame of the operator control.

- Remove the screws ([Folding away the control unit/1](#)) (one on the left and one on the right side).



**Fig.4** Folding away the control unit

- Fold down the operator control panel forwards.

If necessary, for example to access the connectors of the power pack, the Control PCB can also be folded away. Fold away the Control PCB as described in the following.

- Remove the screws ([Folding away the Control PCB/1](#)).



**Fig.5** Folding away the Control PCB

- Fold away the Control PCB.

## Removing the rear panel



**Hazardous voltage. Touching live components can lead to serious injury or death. Before opening the unit, unplug the power plug from the socket-outlet and remove the fuse ([Rear view of the unit, fuse/1](#)).**

- Carefully pry the fuse ([Rear view of the unit, fuse/1](#)) off its holder using a small screwdriver or a similar tool.



**Fig.6** Rear view of the unit, fuse





**Electrostatic discharge may damage electrostatic sensitive devices. When handling electrostatic sensitive devices use a static-dissipative mat and a wrist strap.**

- Switch off the device.
- Unplug power plug from socket-outlet.
- Disconnect the O<sub>2</sub> compressed gas supply.
- Squeeze the filter clamps ([Filter cover/1](#)) and remove the filter cover.



**Fig.7** Filter cover

- Remove the screws ([Removing the rear panel/1](#)).



**Fig.8** Removing the rear panel

- Remove rear panel.



When mounting the rear panel, make sure the hoses point to the left. Otherwise the hoses could buckle (which could lead to error message "O2 measurement").



**Fig.9** Position of hoses

## Power pack

### General information about the power pack

In case of repair, replace complete power pack.

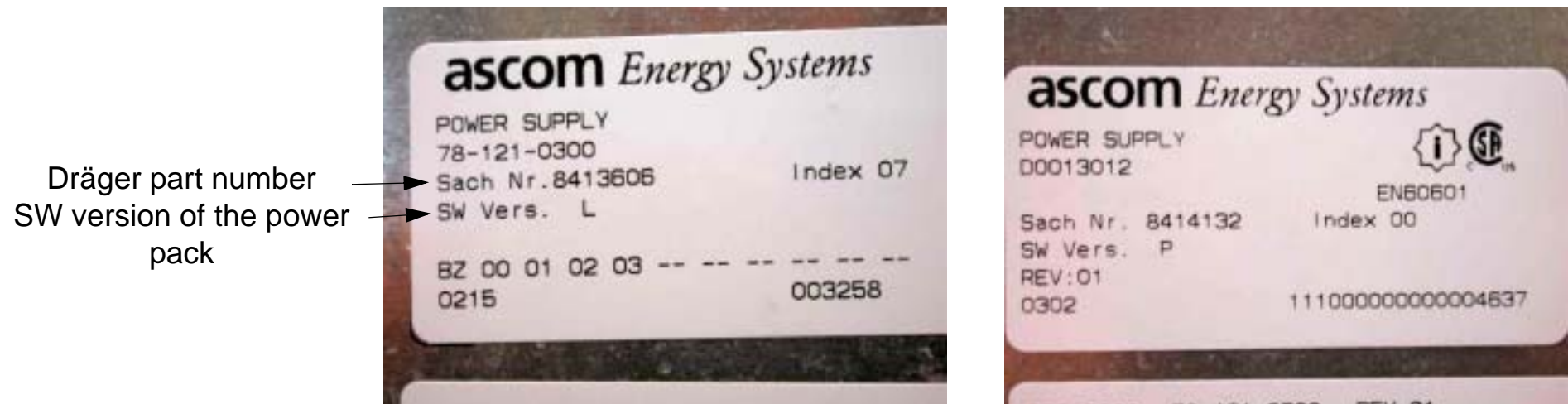
### Identification of the power pack's hardware version

For identification, the power pack needs to be removed from the unit.



**Fig.10** Rear view of the unit, power pack pulled out a short way

The following illustrations show the labels of the power pack. The power pack with the Dräger part number 8413606 (SW version of power pack: "H-L") has been installed in all Savina units manufactured until approx. March 2003. As of April 2003, the power pack with Dräger part number 8414132 (as of SW version of power pack: "P") will be installed in Savina.



**Fig.11** Power pack labels; left-hand illustrations shows SW version L, right-hand illustration shows SW version P (as of April 2003)



As of Savina software version 2.0 the software version of the power pack can be read out in DrägerService mode, test step 29.

## Measuring the supply voltages

The power pack delivers the following supply voltages:

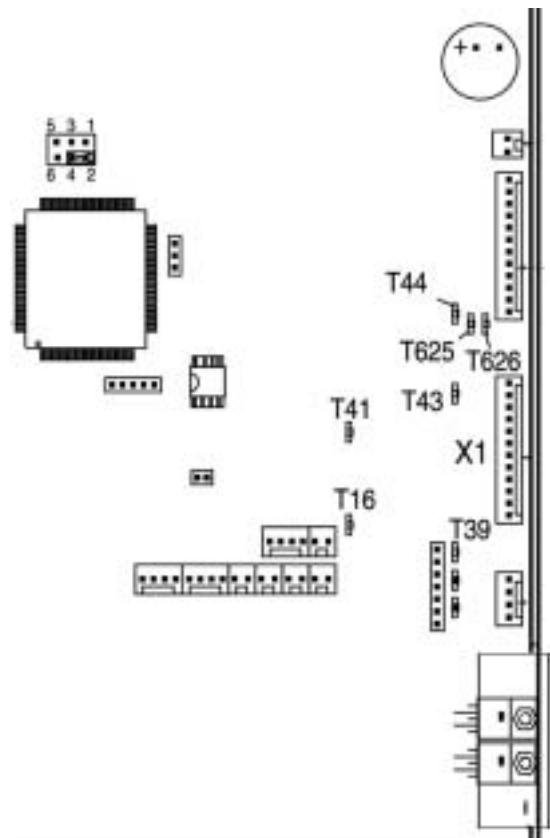
+5 V)    —15 V)    +15 V)    +24 V)    +48 V)

The +48 V are fed directly from the power pack to the Motor Drive PCB. The remaining voltages are fed to the Control PCB and from there to the other PCBs and component devices.

The voltages can be measured on the Control PCB (except the +48 V). The control unit must be opened to access the measuring points (see "[Opening the operator control panel](#)"). The voltages are also displayed in DrägerService Mode, "Test Step 4".

Voltage	Pin assignment, connector X1	Test point
+5 V)	2/4	T43
DGND	1/3	T44
—15 V)	11/12	T41
+15 V)	8/9	T16
AGND	7/10	T39
+24 V)	6	T625
AGND	5	T626

Voltage	Pin assignment, connector X1	Test point
Battery	The battery voltage must be measured directly at the battery (see Maintenance Procedure, chapter "Replacing the internal rechargeable batteries"). It can also be measured between the battery fuse and the external voltage supply connection (see also "Repair Information/Error Events", chapter "Starting aid for charging of internal battery").	



**Fig.12** Detail of the Control PCB, voltage test points

## Replacing the power pack

1. Switch off the device.
2. Unplug the power plug of the device from the socket-outlet.
3. Disconnect the connector of the (optional) external battery from the device.
4. Carefully pry the fuse "F3" (see Fig: [Rear view of the unit, fuse "F3"](#)) off its holder using a small screwdriver or a similar tool.



**Fig.13** Rear view of the unit, fuse "F3"



5. Squeeze the filter clamps ([Rear view of the unit, filter cover/1](#)) and remove the filter cover.



**Fig.14** Rear view of the unit, filter cover

6. Remove the screws ([Rear view of the unit; rear panel/1](#)).



**Fig.15** Rear view of the unit; rear panel

7. Remove the rear panel and put it aside.

8. Remove the screw (see Fig: [Rear view of the unit; power pack](#)).

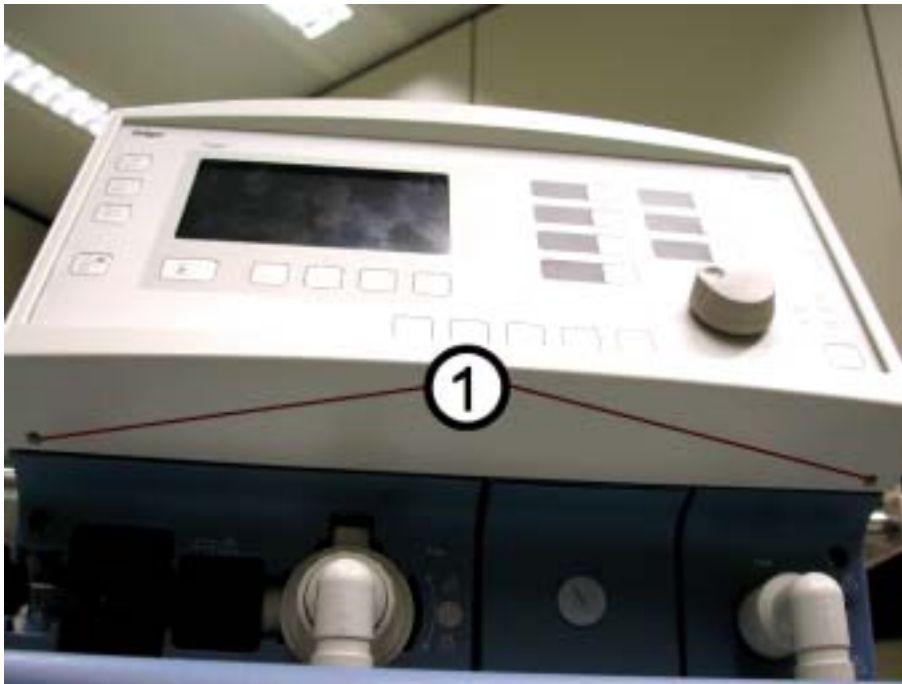


**Fig.16** Rear view of the unit; power pack



The screws of the front frame are secured with Loctite.

- Using an Allen key (size 3 mm) loosen the Allen screw ([Bottom view of the control unit; mounting of the front frame/1](#)) on the front frame a few turns (**Note: older units have slotted-head screws!**).



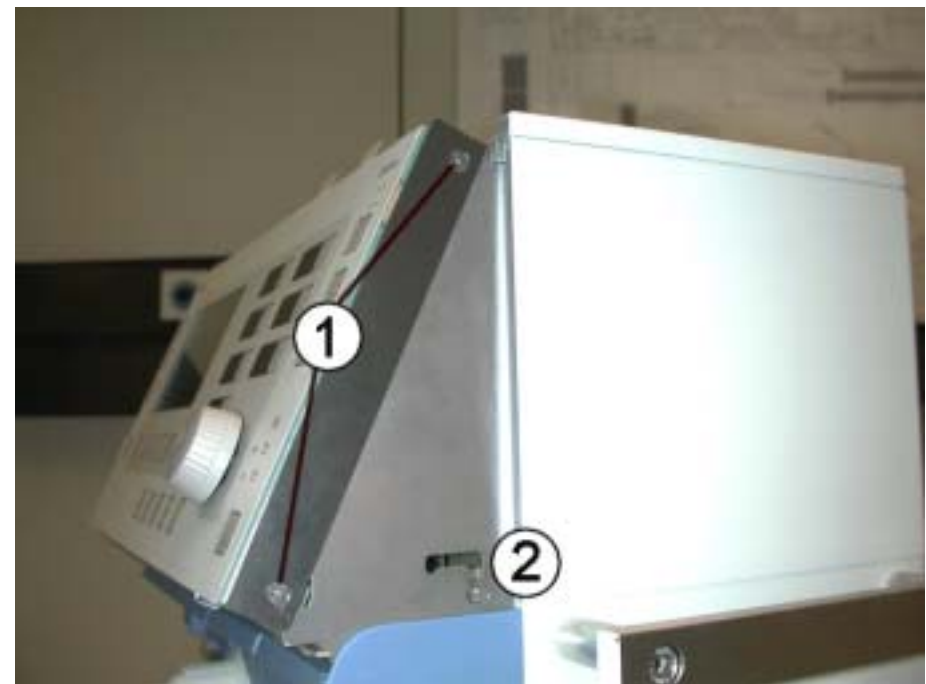
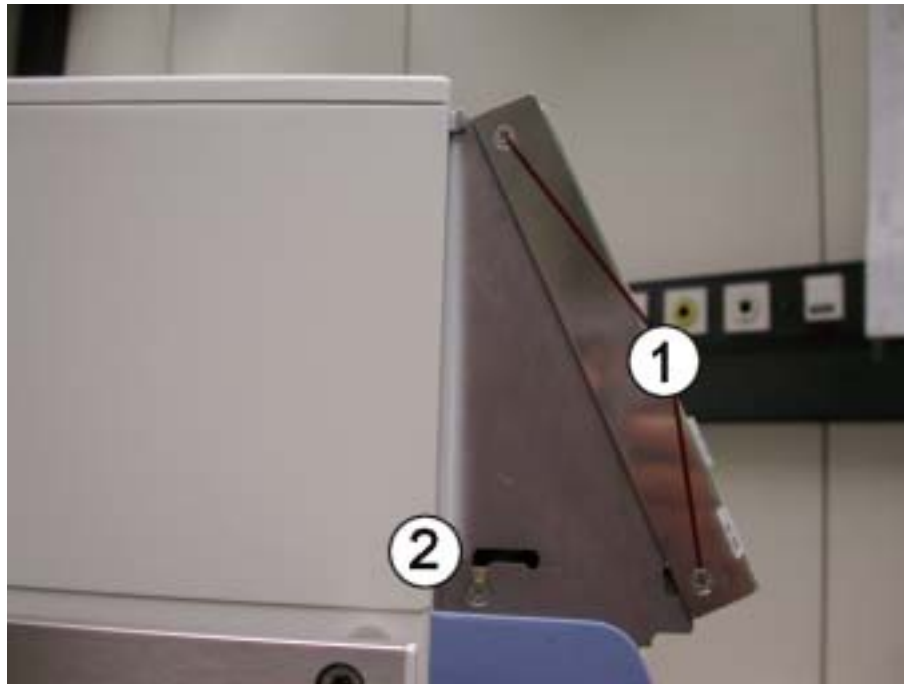
**Fig.17** Bottom view of the control unit; mounting of the front frame

10. Push the front frame away from the control unit.



**Fig.18** Front view of the unit; front frame

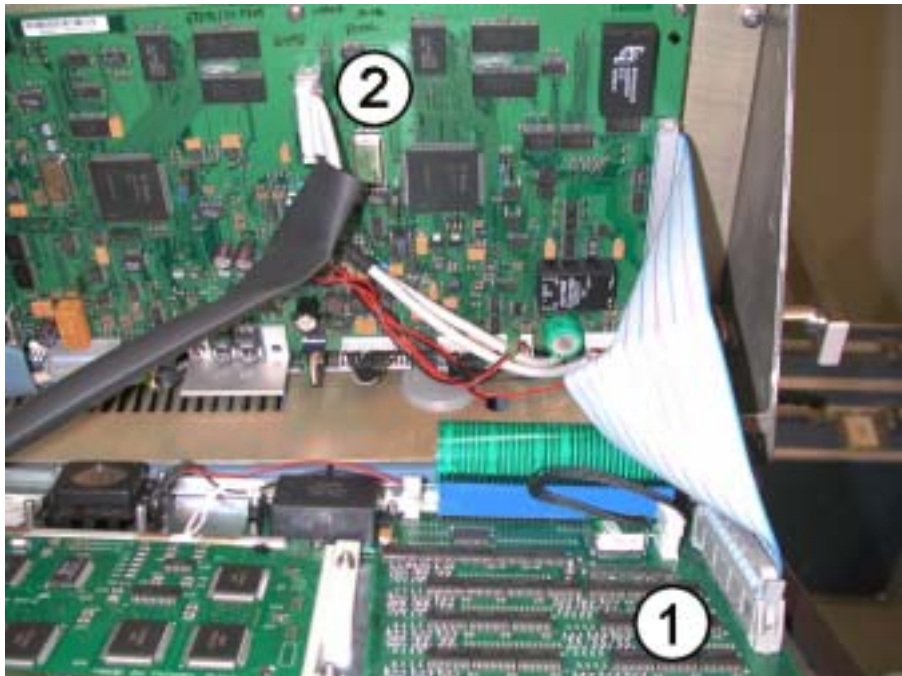
11. Slacken (but do not remove) the screws ([Left- and right-hand side view of the device/2](#)).
12. Using one hand, secure the control unit from falling down, remove the screws and plates ([Left- and right-hand side view of the device/1](#)) from the left-hand and right-hand sides of the device and put the control unit aside.



**Fig.19** Left- and right-hand side view of the device

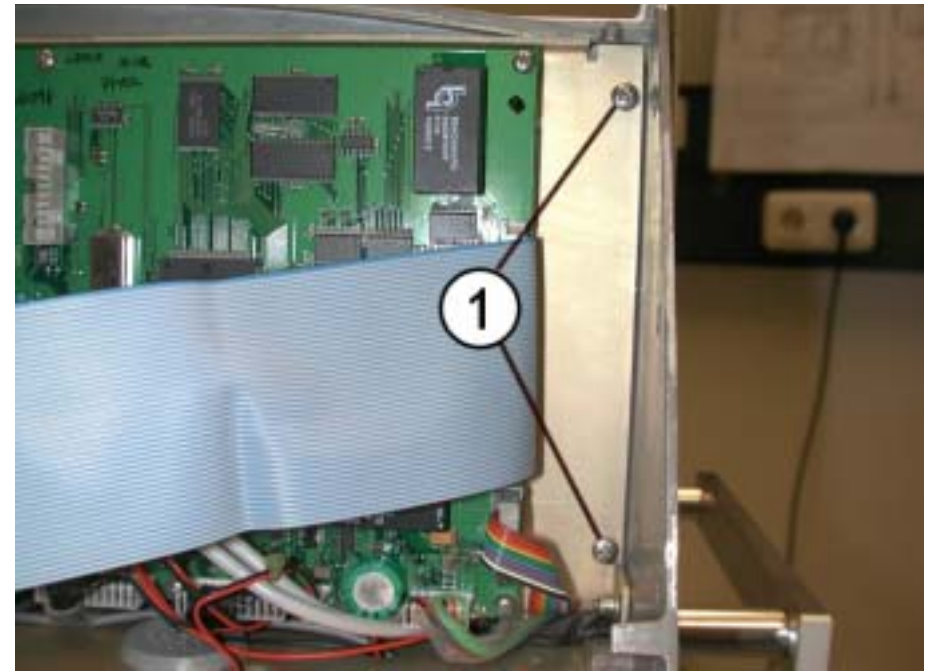
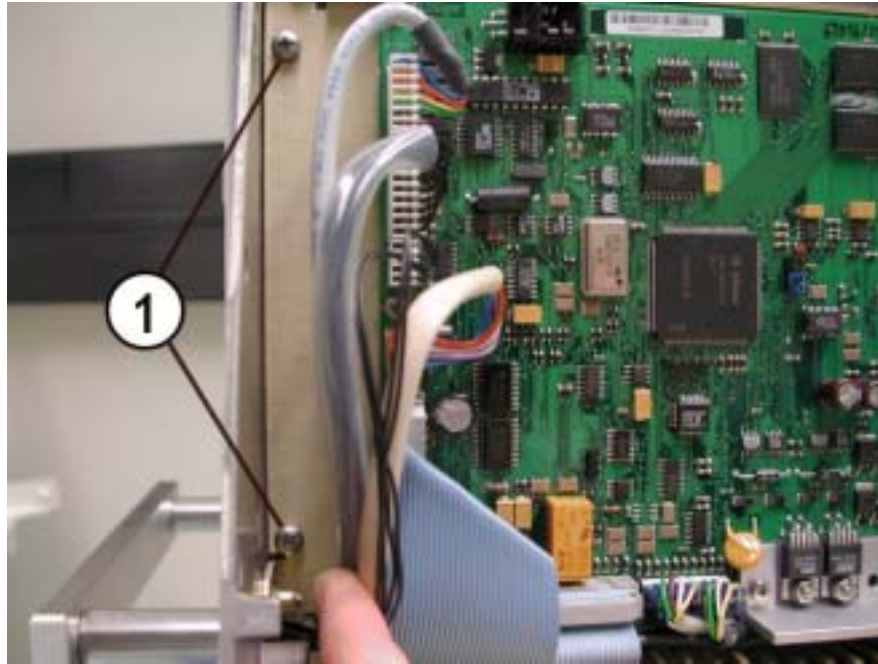


13. Lift the control unit slightly up, unlock the socket's lock (**control unit; cable connector/1**) and pull out the cable connector.
14. Disconnect the cable connector (**control unit; cable connector/2**) from the Control PCB and put the control unit aside.



**Fig.20** control unit; cable connector

15. Remove screws and washers (Left-hand and right-hand front views; mounting the frame/1) on the left-hand and right-hand sides of the frame.



**Fig.21** Left-hand and right-hand front views; mounting the frame

16. Carefully pull the frame slightly out of the housing, lift the frame slightly up and fold the frame down to the front with the help of the frame guide.



17. Disconnect all cable connectors ([Front view of the power pack; cable connections/1](#)) from the power pack.



**Fig.22** Front view of the power pack; cable connections

18. Remove the faulty power pack from the device (at the rear) and put it aside.

19. Insert the new power pack into the device (at the rear), and secure the power pack to the device using **only one screw** (at the top right), see Fig: [Power pack; attachment](#).

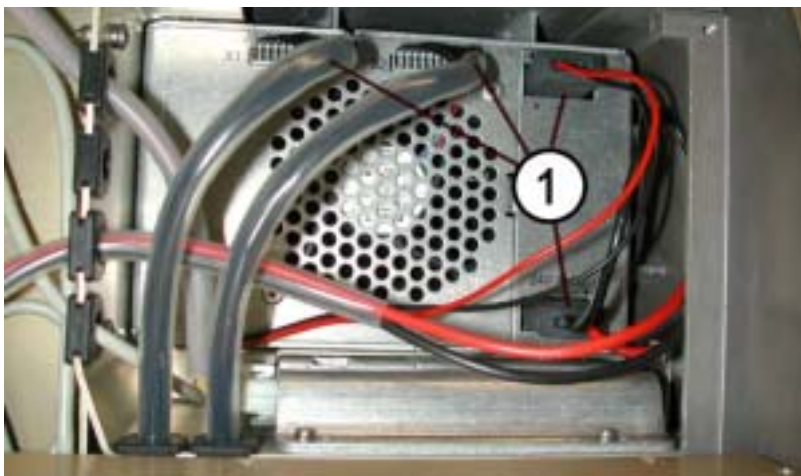


**Fig.23** Power pack; attachment



**Cables are not coded. Incorrectly connected cables can damage the power pack and the Control PCB. When connecting cables, make sure the cable connector with the larger conductor cross section is connected to the socket at the bottom right of the power pack! Check the following figure for the correct configuration of connections.**

20. Connect all cable connectors to their respective sockets on the power pack, see Fig: [Power pack; cable connections](#) (Note: the cable connector with the larger conductor cross section must be connected to the socket at the bottom right of the power pack!).
21. Lay the cables properly in the unit to avoid squeezing.



**Fig.24** Power pack; cable connections

22. Fold the frame up and push to the rear.



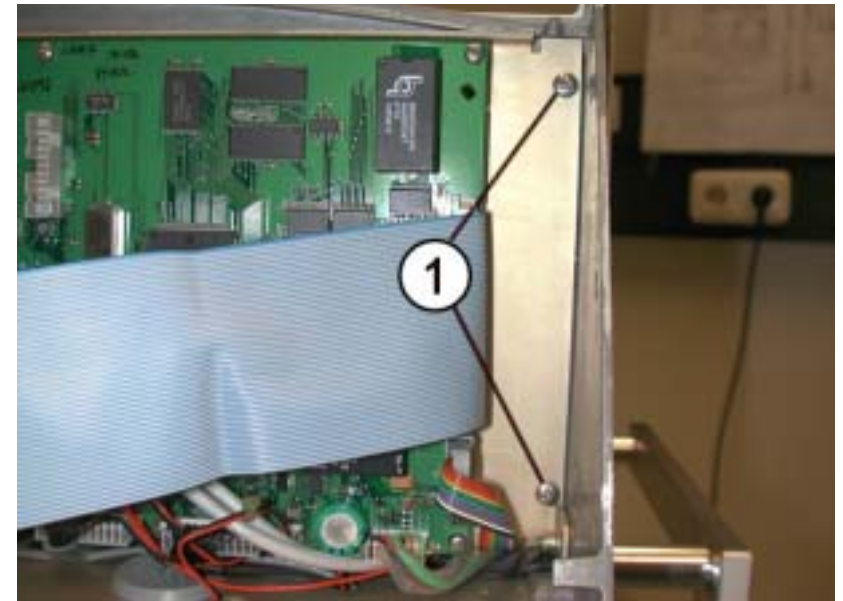
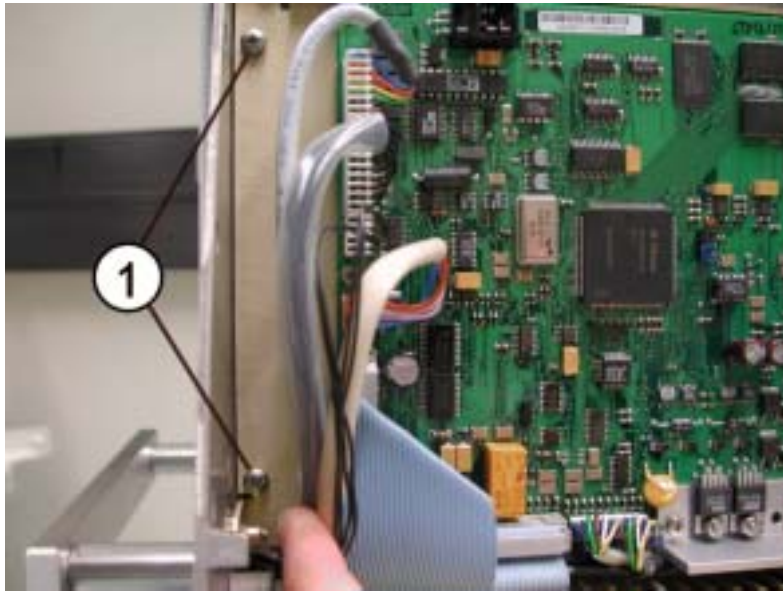
**Risk of squeezing of or damage to the cables due to improper mounting of the frame. When securing the frame, make sure no cable is squeezed or damaged.**

Since 2002, the transition from control unit to housing has been completely covered with a special sealing rubber in order to improve the electrical insulation at the bottom of the frame. This makes it harder to reattach the frame. In the event of problems, open the frame again. The impressions on the sealing rubber show where the cables were laid out.

Tip: before you attach the frame, push the AWT temperature sensor cable between the rear edge of the piezo signal generator and the sealing rubber.

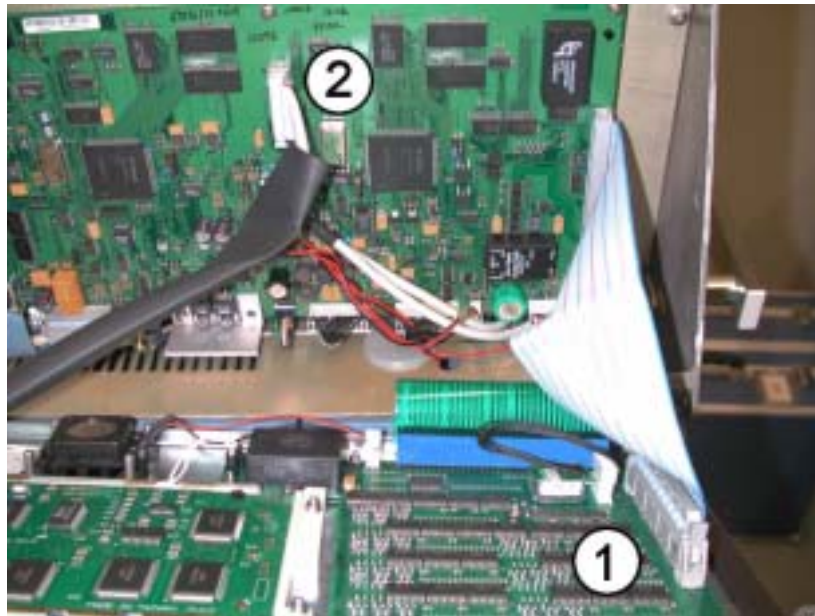
23. Push the frame down and fit it into the device without squeezing or damaging any cables.

24. Secure the frame to the device using screws and washers (Left-hand and right-hand front views; mounting the frame/1).



**Fig.25** Left-hand and right-hand front views; mounting the frame

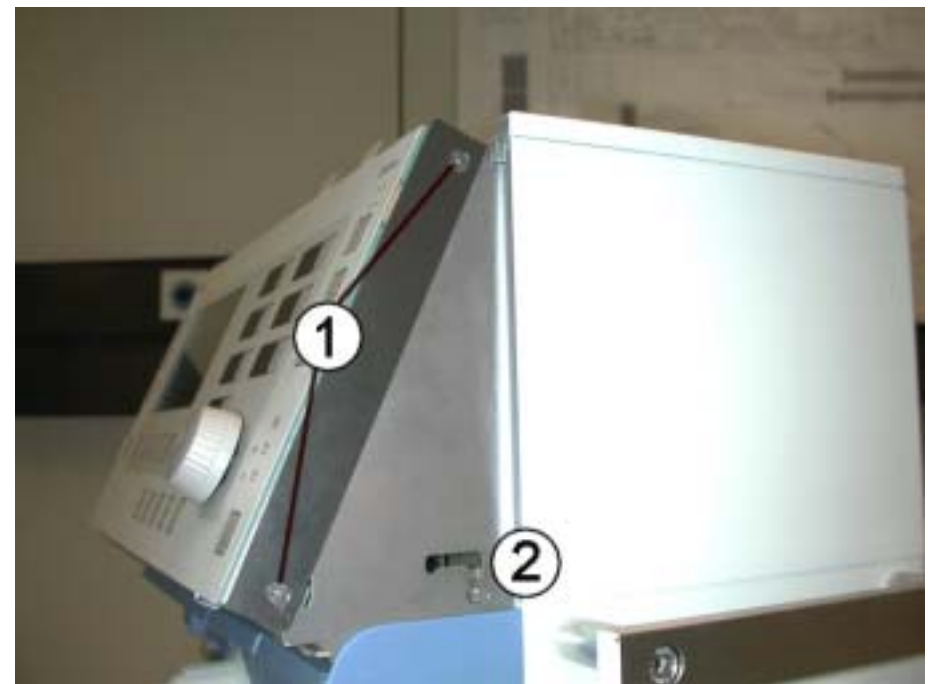
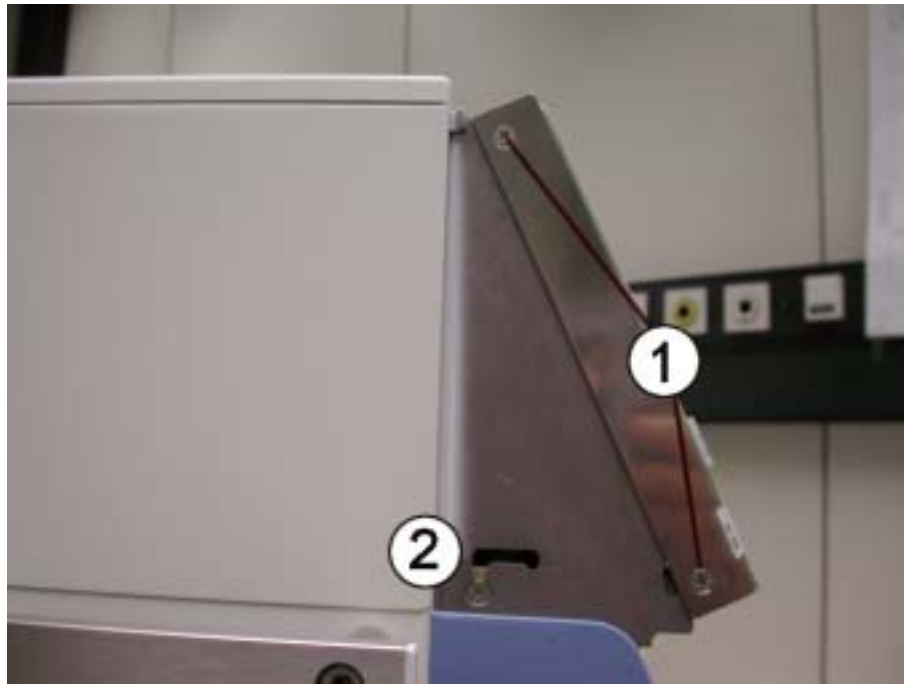
25. Connect the cable connector ([Detail of the control unit; cable connector/1](#)) to the socket on the control unit, and lock the cable connector in the socket.
26. Connect the cable connector of the control unit ([Detail of the control unit; cable connector/2](#)) to the socket on the Control PCB.



**Fig.26** Detail of the control unit; cable connector

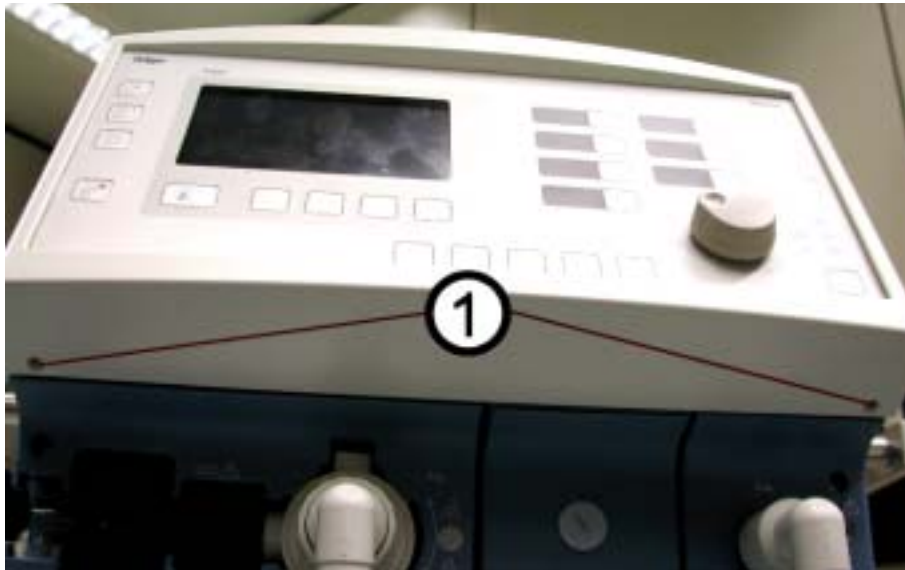


27. Secure the control unit to the device using the plates and screws ([Left- and right-hand side view of the device; plates/1](#)).
28. Tighten the screws ([Left- and right-hand side view of the device; plates/2](#)) at the left-hand and right-hand sides of the device.



**Fig.27** Left- and right-hand side view of the device; plates

29. Slide the front frame over the control unit.
30. Secure the front frame to the control unit using the Allen screws ([Bottom view of the control unit; mounting of the front frame/1](#)).
31. Apply Loctite 221 on the heads of the Allen screws.



**Fig.28** Bottom view of the control unit; mounting of the front frame

32. Secure the rear panel to the device.
33. Secure the filter frame to the device.



34. Plug the power plug of the device into the socket-outlet.
35. Press the fuse "F3" into its holder (Note: the fuse is located on the back of the device).
36. Switch on unit.
37. Carry out an electrical safety test as per PMS procedure. For the USA and Canada: test according to CAN/CSA-22.2 No. 601.1-M90.
38. Carry out functional tests as per Instructions for Use manual.

## O2 valve block

### Checking the O2 output of the O2 valve block

39. Switch the unit off with the ON/OFF switch.
40. Unplug the power plug of the device from the socket-outlet.
41. Pry the fuse "F3" (external battery) off its holder on the rear panel of the unit.



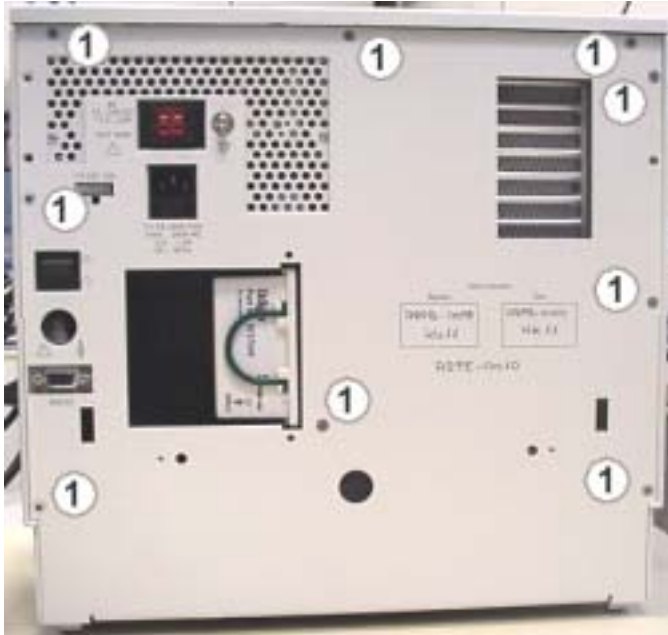
**Fig.29** Rear view of the unit, fuse

42. Push the clamps ([Rear view of the unit, filter cover/1](#)) of the filter cover in, lift the filter cover slightly at its underside, and remove the filter cover from the cover.



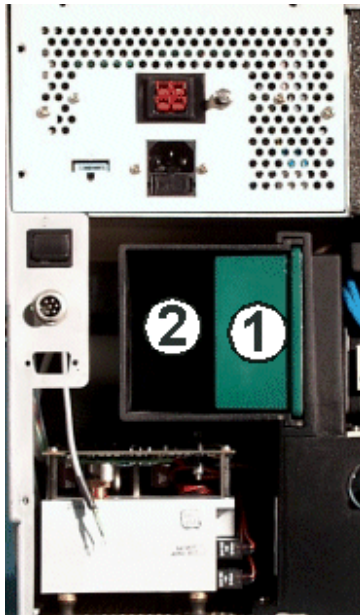
**Fig.30** Rear view of the unit, filter cover

43. Remove the screws (Rear panel/1) and put the rear panel aside.



**Fig.31** Rear panel

44. Remove the filter ([Rear view of the unit, filter box/1](#)).
45. Pull out the filter box ([Rear view of the unit, filter box/2](#)).



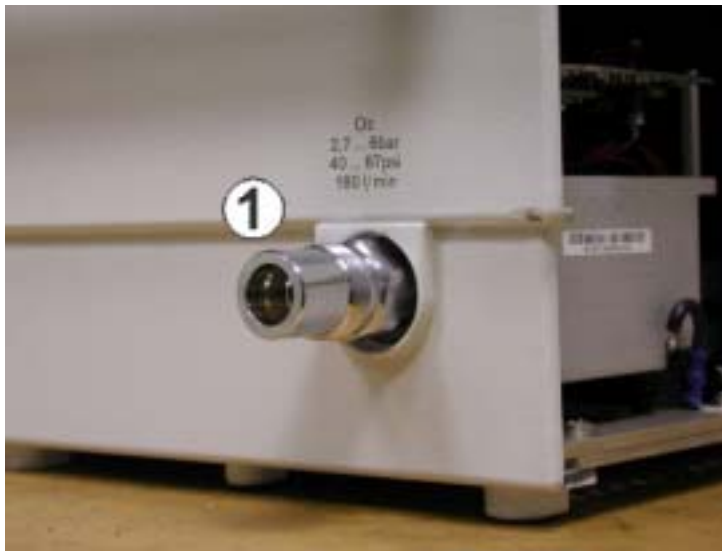
**Fig.32** Rear view of the unit, filter box

46. Carefully remove the TSI sensor (**TSI sensor**) from the plug-in module and place the TSI-Sensor in direction of the front panel.



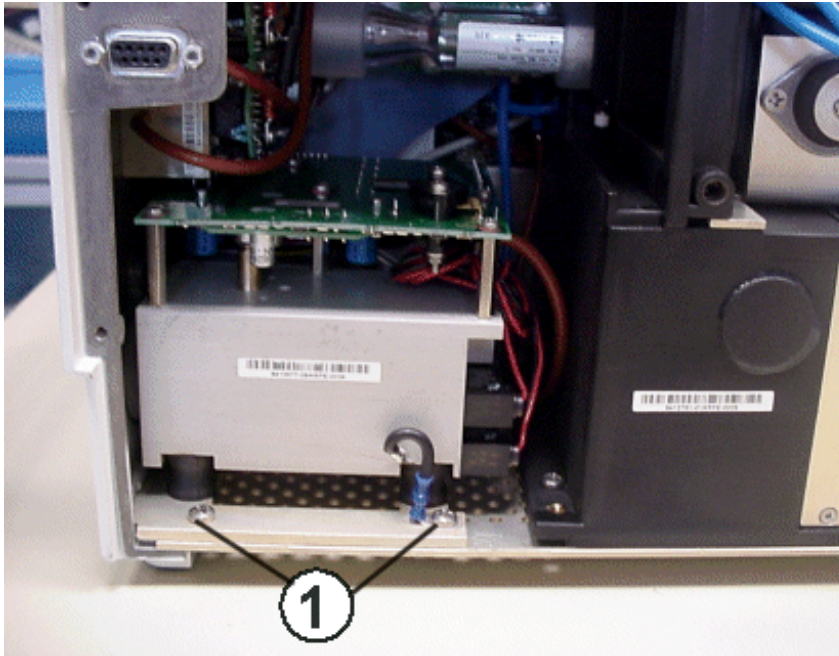
**Fig.33** TSI sensor

47. Unscrew, for example, the "NIST connector" (see Fig: [connector](#); [NIST connector](#)/1) from the O2 valve block using plastic-jaw pliers (**Note: the NIST, DIN, Air Liquide, or DIS connectors have washers that need to be replaced after each removal of the connector!**).



**Fig.34** connector; NIST connector

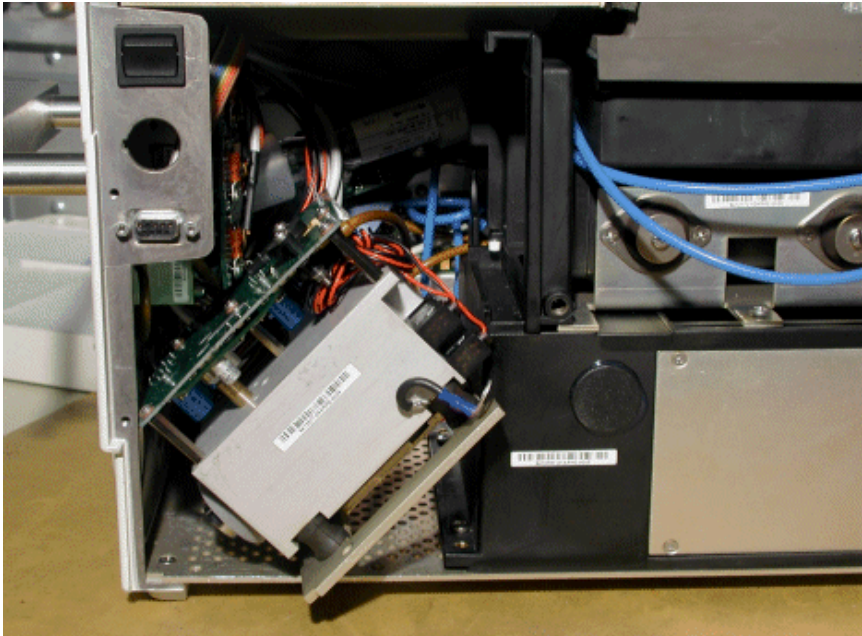
48. Remove the screws (O2 valve block, screws/1) from the O2 valve block.



**Fig.35** O2 valve block, screws

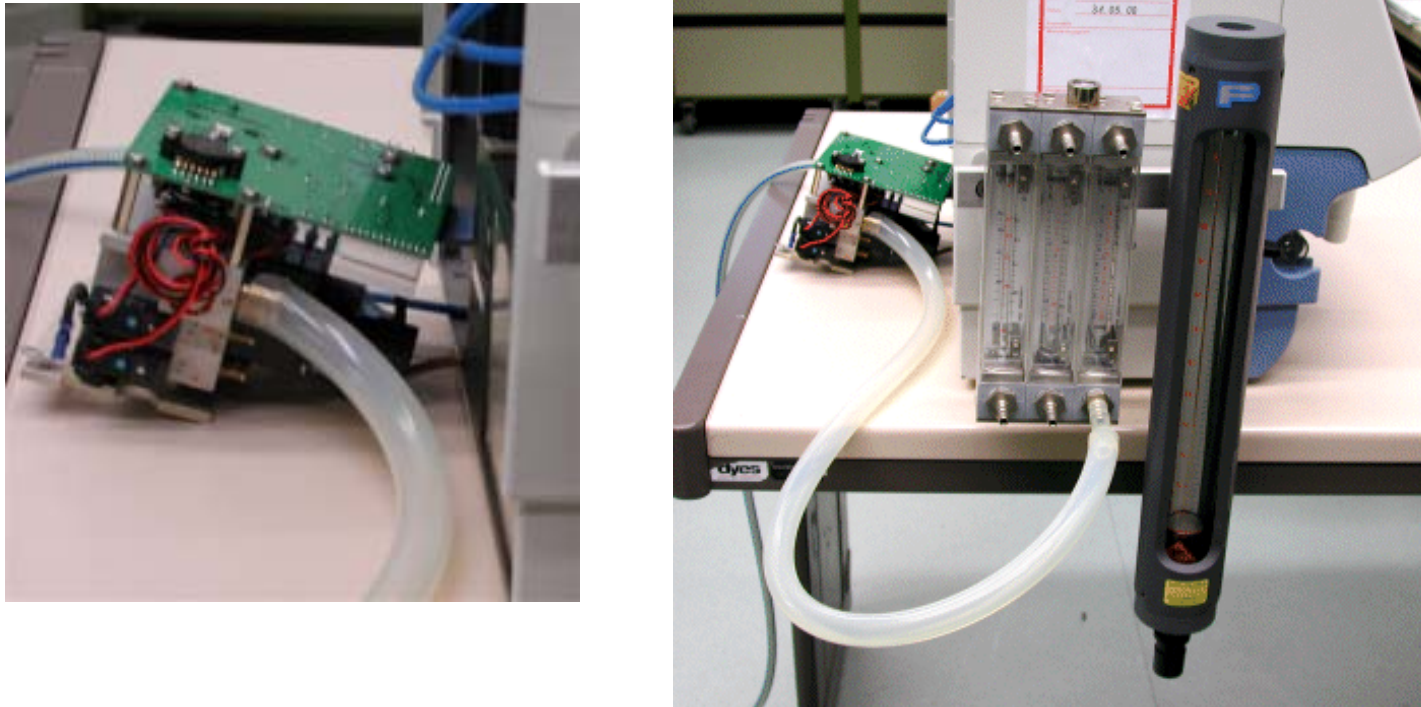


49. Pull the O2 valve block out a little, tilt it and disconnect all silicone hoses from the O2 valve block.



**Fig.36** O2 valve block, silicone hoses

50. Connect the following test set-up to the O2 valve block.



**Fig.37** Test set-up

- 51. Connect the O2 gas supply to the O2 valve block.
- 52. Insert the fuse "F3" (external battery) into its holder on the rear panel of the unit.
- 53. Plug the power plug of the device into the socket-outlet.



**Hazardous voltage. Touching live components can lead to serious injury or death.**

54. Start the unit in DrägerService mode by pressing and holding the "Config" and "Dim-up/dim-down" keys while switching on the unit.
55. Call up "test step 5".
56. Select valves (1 to 8) one after the other, read the pressure on the display, round off the pressure value, and compare the flow with the flow values listed in the following tables (Note: The tolerance for all flows is  $\pm 10\%$ !).

## Valve test

The following example describes the test procedure for valve "5":

Valve no. 5 is activated, O2 supply pressure = 4730 mbar; round off the pressure value to 4.7, the flow should be 18.7 L.

1. Select "Valve 5".
2. Switch the valve on, "Valve status: ON".

3. Read the pressure on the display, "O2 supply pressure: 4730 mbar".
4. Convert the pressure value to bar and round off to one decimal place after the decimal point, e.g., 4730 mbar to 4.7 bar.
5. Read the flow on the flowmeter tube, and compare the reading with the value given in the table.

The measured flow is 18.7 L  $\pm$ 10%.

### Key to the following valve test tables

The valve test tables are valid for an atmospheric pressure of 1013 mbar (hPa).

	Absolute pressure value in bar									
Valve	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
1	24.9 l	25.9 l	26.9 l	27.9 l	28.9 l	29.9 l	30.9 l	31.9 l	32.9 l	33.9 l
2	24.9 l	25.9 l	26.9 l	27.9 l	28.9 l	29.9 l	30.9 l	31.9 l	32.9 l	33.9 l
3	24.9 l	25.9 l	26.9 l	27.9 l	28.9 l	29.9 l	30.9 l	31.9 l	32.9 l	33.9 l
4	24.9 l	25.9 l	26.9 l	27.9 l	28.9 l	29.9 l	30.9 l	31.9 l	32.9 l	33.9 l
5	10.0 l	10.4 l	10.8 l	11.2 l	11.5 l	11.9 l	12.3 l	12.7 l	13.1 l	13.5 l
6	10.0 l	10.4 l	10.8 l	11.2 l	11.5 l	11.9 l	12.3 l	12.7 l	13.1 l	13.5 l
7	3.2 l	3.4 l	3.5 l	3.6 l	3.8 l	3.9 l	4.0 l	4.1 l	4.3 l	4.4 l
8	3.2 l	3.4 l	3.5 l	3.6 l	3.8 l	3.9 l	4.0 l	4.1 l	4.3 l	4.4 l

	Absolute pressure value in bar									
Valve	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4
1	34.8 l	35.8 l	36.8 l	37.8 l	38.8 l	39.8 l	40.8 l	41.8 l	42.8 l	43.8 l
2	34.8 l	35.8 l	36.8 l	37.8 l	38.8 l	39.8 l	40.8 l	41.8 l	42.8 l	43.8 l
3	34.8 l	35.8 l	36.8 l	37.8 l	38.8 l	39.8 l	40.8 l	41.8 l	42.8 l	43.8 l
4	34.8 l	35.8 l	36.8 l	37.8 l	38.8 l	39.8 l	40.8 l	41.8 l	42.8 l	43.8 l
5	13.9 l	14.3 l	14.7 l	15.1 l	15.5 l	15.9 l	16.3 l	16.7 l	17.1 l	17.5 l
6	13.9 l	14.3 l	14.7 l	15.1 l	15.5 l	15.9 l	16.3 l	16.7 l	17.1 l	17.5 l
7	4.5 l	4.7 l	4.8 l	4.9 l	5.0 l	5.2 l	5.3 l	5.4 l	5.6 l	5.7 l
8	4.5 l	4.7 l	4.8 l	4.9 l	5.0 l	5.2 l	5.3 l	5.4 l	5.6 l	5.7 l

	Absolute pressure value in bar									
Valve	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4
1	44.8 l	45.8 l	46.8 l	47.8 l	48.8 l	49.8 l	50.8 l	51.8 l	52.8 l	53.8 l
2	44.8 l	45.8 l	46.8 l	47.8 l	48.8 l	49.8 l	50.8 l	51.8 l	52.8 l	53.8 l
3	44.8 l	45.8 l	46.8 l	47.8 l	48.8 l	49.8 l	50.8 l	51.8 l	52.8 l	53.8 l
4	44.8 l	45.8 l	46.8 l	47.8 l	48.8 l	49.8 l	50.8 l	51.8 l	52.8 l	53.8 l
5	17.9 l	18.3 l	18.7 l	19.1 l	19.5 l	19.9 l	20.3 l	20.7 l	21.1 l	21.5 l
6	17.9 l	18.3 l	18.7 l	19.1 l	19.5 l	19.9 l	20.3 l	20.7 l	21.1 l	21.5 l
7	5.8 l	6.0 l	6.1 l	6.2 l	6.3 l	6.5 l	6.6 l	6.7 l	6.9 l	7.0 l
8	5.8 l	6.0 l	6.1 l	6.2 l	6.3 l	6.5 l	6.6 l	6.7 l	6.9 l	7.0 l



	Absolute pressure value in bar					
Valve	5.5	5.6	5.7	5.8	5.9	6.0
1	54.8 l	55.8 l	56.8 l	57.7 l	58.7 l	59.7 l
2	54.8 l	55.8 l	56.8 l	57.7 l	58.7 l	59.7 l
3	54.8 l	55.8 l	56.8 l	57.7 l	58.7 l	59.7 l
4	54.8 l	55.8 l	56.8 l	57.7 l	58.7 l	59.7 l
5	21.9 l	22.3 l	22.7 l	23.1 l	23.5 l	23.9 l
6	21.9 l	22.3 l	22.7 l	23.1 l	23.5 l	23.9 l
7	7.1 l	7.2 l	7.4 l	7.5 l	7.6 l	7.8 l
8	7.1 l	7.2 l	7.4 l	7.5 l	7.6 l	7.8 l

If the flow values are incorrect, there could be the following reasons:

- The O2 supply is not connected.
- Broken rocker plate in the O2 valve block (supplies a flow although the O2 valve block is not triggered).
- Faulty solenoid valve.

If there is a broken rocker plate or a faulty solenoid valve, the O2 valve block must be replaced with a new one.



With an intact O2 valve block (no valve is triggered) the permissible leakage flow is less than or equal to 8 ml at 3 bar relative.

(Note: Absolute pressure = relative pressure + ambient pressure)

If all values are OK, assemble the unit as follows:

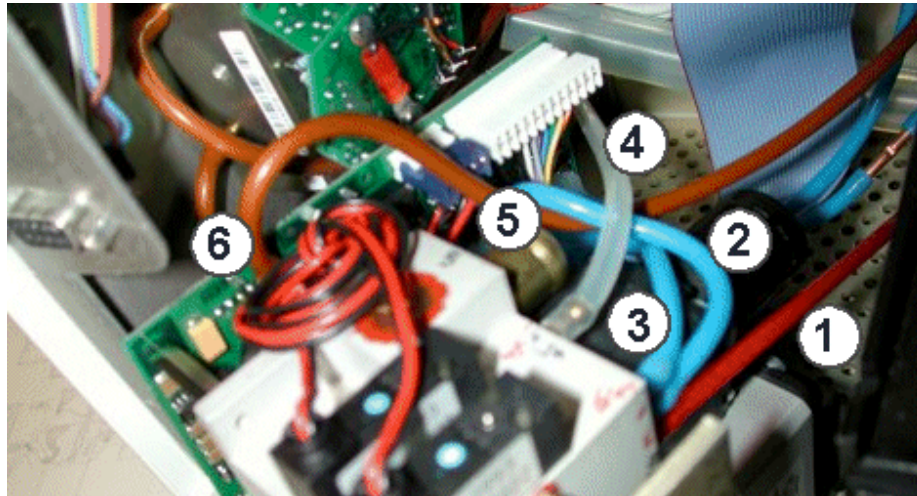
6. Switch off the device.
7. Take power plug out of mains socket.
8. Pry the fuse "F3" (external battery) off its holder on the rear panel of the unit.
9. Remove the test set-up.
10. Disconnect the unit from the O2 supply.

11. Insert the TSI sensor into the holder and push the TSI sensor firmly to the right.



**Fig.38** TSI sensor

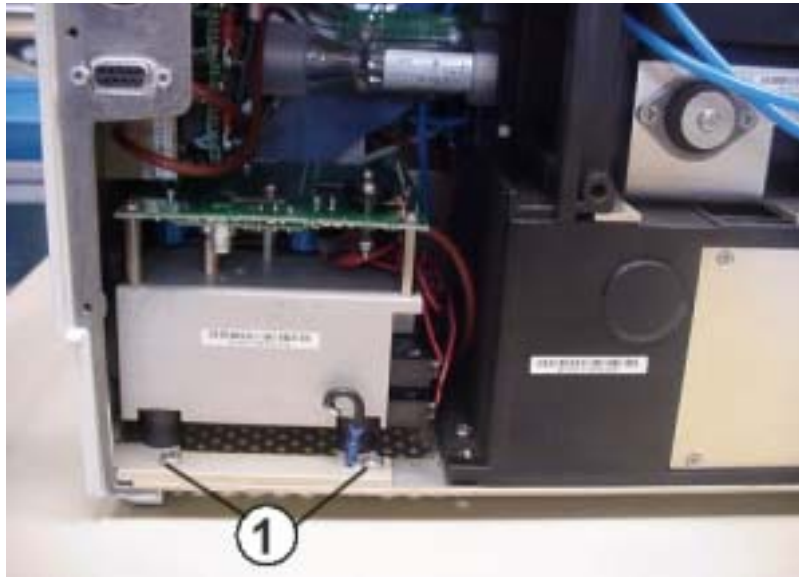
12. Connect the silicone hoses to the O2 valve block, see [O2 valve block tubing](#).



**Fig.39** O2 valve block tubing

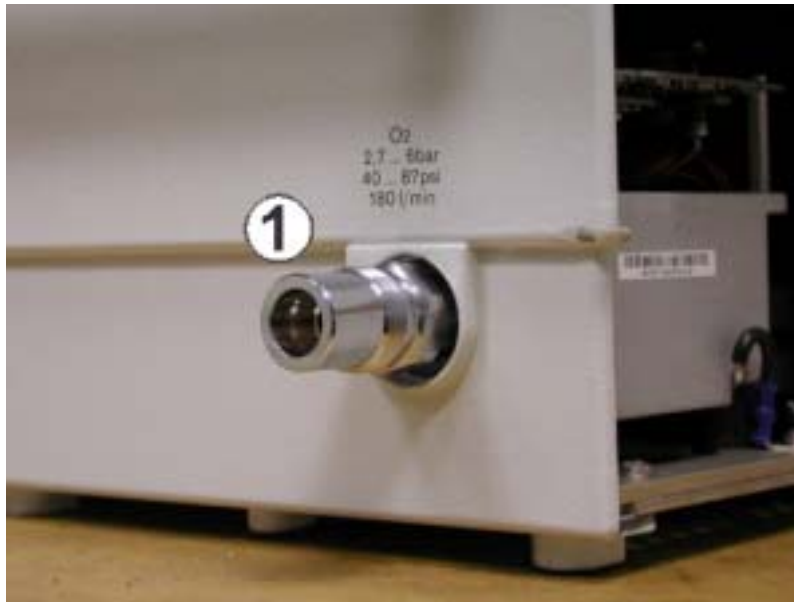
Number	Color	Connection
1	red	Expiratory pressure sensor
2	blue	Blower unit
3	blue	Restrictor for O2 sensor mount
4	transparent (small)	Nebulizer
5	transparent (large)	Plug-in unit
6	brown	Plug-in unit/O2 sensor mount

13. Place the O2 valve block into its mounting position.
14. Secure the O2 valve block to the unit using the screws ([O2 valve block/1](#)) (Note: Mount also the earthing to the right screw).



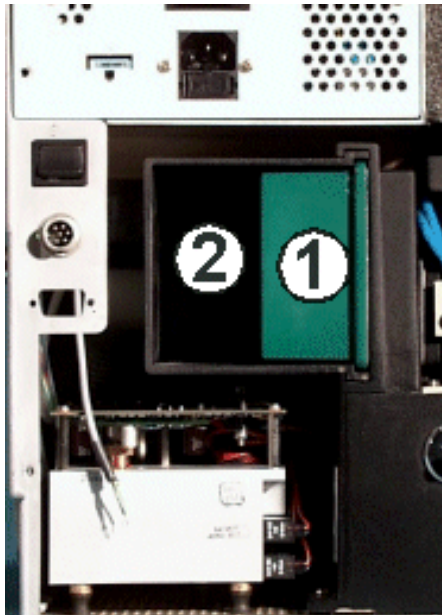
**Fig.40** O2 valve block

15. Mount the connector to the O2 valve block using plastic-jaw pliers (**Note: the NIST, DIN, Air Liquide, or DIS connectors have washers that need to be replaced after each removal of the connector!**).



**Fig.41** Connection

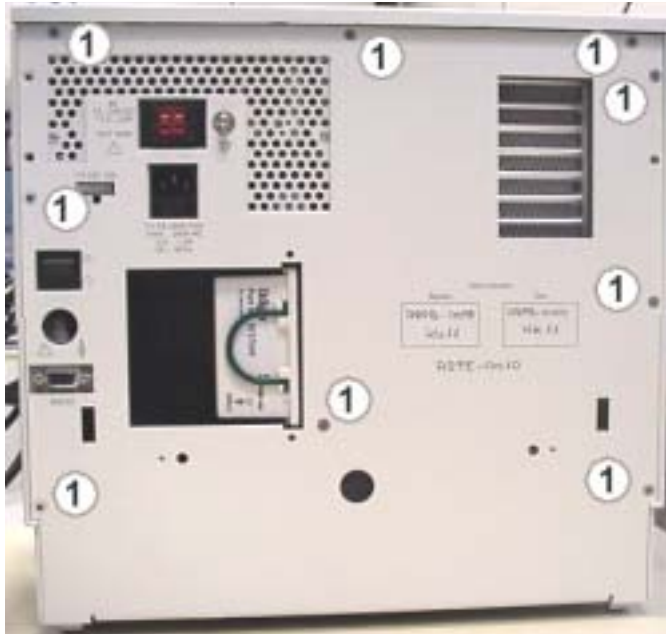
16. Push the filter box ([Rear view of the unit, filter box/2](#)) into the guide of the unit.
17. Insert the filter ([Rear view of the unit, filter box/1](#)) into the filter box.



**Fig.42** Rear view of the unit, filter box



18. Use the screws (Rear panel/1) to secure the rear panel to the unit.



**Fig.43** Rear panel

19. Squeeze the clamps ([Filter cover/1](#)), push the filter cover with the grooves under the housing cover, and fit the filter cover to the recesses on the rear panel using the clamps.



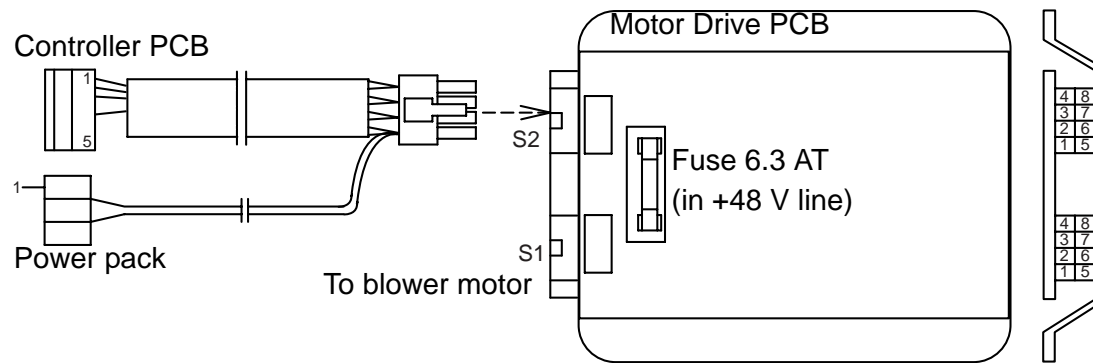
**Fig.44** Filter cover

20. Insert the fuse "F3" (external battery) into its holder on the rear panel of the unit.
21. Plug the power plug of the device into the socket-outlet.
22. Connect the unit to the O2 supply.
23. Switch on unit.

24. Check the electrical safety and the correct functioning of the device as described in the PMS procedure (Test Certificate).
25. Enter previously noted customer-specific parameters in the unit.

## Motor Drive PCB

The PCB is on the right behind the Control PCB (see also "Schematics and Diagrams", figure "Front view with front panel and Control PCB folded away").



**Fig.45** View of the Motor Drive PCB

## Pin assignment of the Motor Drive PCB

Pin	Connector S2 (to Control PCB/power pack)	Connector S1 (to blower motor)
1	Enable	Motor phase 3 (L3)
2	Operating voltage (+Ub, +48 V)	Supply to Hall sensor system (+U-Hall)
3	Not assigned	Hall signal 2 (RLG2)
4	Target speed (0 to +4.75 V)	Hall signal 1 (RLG1)
5	Not assigned	Motor phase 2 (L2)
6	Actual speed (6 pulses per revolution)	Motor phase 1 (L1)
7	Operating voltage GND	Supply to Hall sensor system (GND-Hall)
8	Target speed (-)	Hall signal 3 (RLG3)

## Fan

The fan is on the left behind the Control PCB (see also "Schematics and Diagrams", figure "Front view with front panel and Control PCB folded away").

### Pin assignment of the fan

Pin	Connector (to Control PCB)
1	Operating voltage (+Ub, +24 V)
2	Speed signal
3	Speed setpoint (pulse width modulation)
4	GND

## O2 Diaphragm PCB

### Replacing the O2 Diaphragm PCB

The O2 Diaphragm PCB holds the mounts for the O<sub>2</sub> sensors and the measurement electronics. It is located directly behind the O<sub>2</sub> sensors. Replacement procedure:

- Switch off the device.
- Remove the fuse ([Rear view of the unit, fuse/1](#)).



**Fig.46** Rear view of the unit, fuse



- Remove the cover (O<sub>2</sub> sensors cover/1) of the O<sub>2</sub> sensors.



**Fig.47** O<sub>2</sub> sensors cover

- Remove the O<sub>2</sub> sensors.
- Remove the screws of the plastic frame.



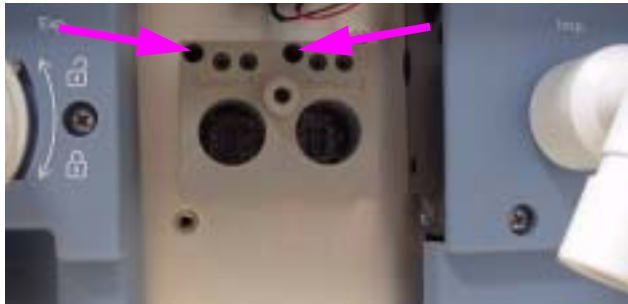
**Fig.48** O<sub>2</sub> sensors, plastic frame

- Remove the plastic frame.



**The O<sub>2</sub> block has tubes and cable connections. These tubes and cable connections could get damaged when removing the O<sub>2</sub> block. Remove the O<sub>2</sub> block from the unit very carefully.**

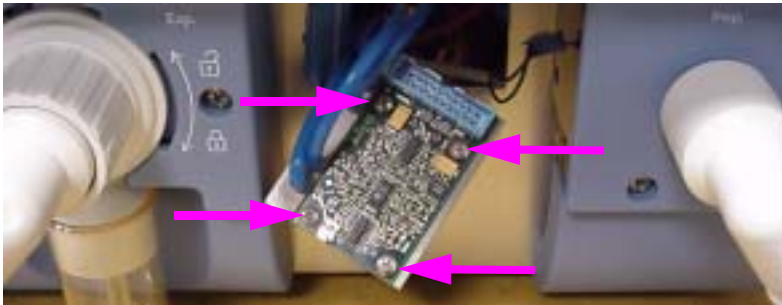
- Remove the screws from the O<sub>2</sub> block.



**Fig.49** O<sub>2</sub> block

- Remove the O<sub>2</sub> block from the unit.
- Remove the connector from the O2 Diaphragm PCB.

- Remove the fixing screws from the O<sub>2</sub> Diaphragm PCB.



**Fig.50** O<sub>2</sub> Diaphragm PCB, position of the fixing screws

- Mount the new 2 Diaphragm PCB
- Reassemble the unit (do not mount the O<sub>2</sub> sensors yet).



After replacing the O<sub>2</sub> Diaphragm PCB, it is necessary to recalibrate the offset of the O<sub>2</sub> measurement electronics (see DrägerService mode, "Test Step 22").

- Mount the O<sub>2</sub> sensors.
- Mount the cover of the O<sub>2</sub> sensors.
- Insert the fuse into its holder on the rear panel.
- Perform the safety check and functional check as per the Test Certificate.

## Pin assignment of the O2 Diaphragm PCB

Only those contacts are listed for which there is a measurement result. For the location of connectors, see also "Schematics and Diagrams", "O<sub>2</sub> Diaphragm PCB".

Pin	Connectors X1, X2
	O <sub>2</sub> sensors connection

Pin	Connector X3
1	NTC in the inspiration block
2	NTC in the inspiration block (internal AGND)

Pin	Connector X4
1	+5 V
4	DGND
7/8	V_batt (approx. +24 V)
9/10	+15 V
17/20	AGND

Pin	Connector X4
	The values of the following signals can be read out in DrägerService mode (see DrägerService mode, "Test Step 17" to "Test Step 19").
11	V_REF_O2
12	V_TEMP_O2
13	V_TEMP_AIR
14	VCC+15V_O2
15	V_FIO2_1
16	V_FIO2_1
18	V_FIO2_2
19	V_FIO2_2

## Bypass valve V1



After replacing the bypass valve, it is necessary to set the calibration class stated on the new bypass valve (see DrägerService Mode, "Test Step 15") and to transfer it to the rear panel (new label).

## Expiratory valve V3



After replacing the expiratory valve, it is necessary to set the calibration class stated on the new expiratory valve (see DrägerService mode, Test Step 15") and to transfer it to the rear panel (new label).

## Replacing the EEPROM

Read the following information before replacing the EEPROM:



**Do not replace the EEPROM and the RTC on the Control PCB at the same time. Otherwise the recorded operating hours will be lost. If you need to replace both components, do it in sequence, that is, complete the replacement of one component first before starting the next one.**

**Existing software options, for example, "BIPAP" and "Autoflow" will be lost and need to be reactivated again. You need to request the required release codes (see also the following description).**

**Replace the EEPROM only with a brand-new EEPROM that has not been in use before.**

**The unit must be off when replacing the EEPROM, and the battery fuse (fuse on rear panel of the unit) must be removed.**

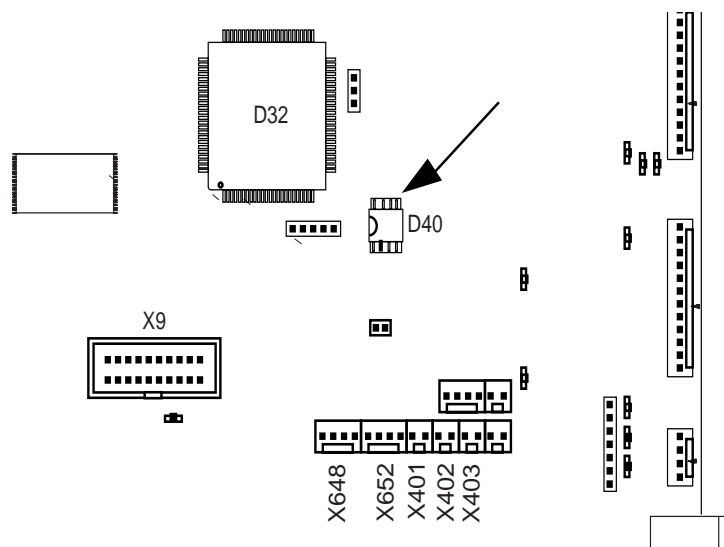
**Ensure the correct polarity. If the polarity of the EEPROM is reversed the EEPROM will be destroyed. Remember the installation position of the EEPROM.**





The information stored in the EEPROM includes operating hours, software options (as of SW 1.01), device ID (as of SW 1.01), language version, volume, contrast, baud rate, and measured value display. This information must be read out and written down before replacing the EEPROM.

- Read out and write down software options (as of SW 1.01) etc.
- Switch off the device.
- Open the device, see [Opening the operator control panel](#).
- Remove EEPROM (D40) from the Control PCB.



**Fig.51** Detail of the Control PCB, EEPROM

- Install brand-new EEPROM.
- Assemble the unit.
- Insert the "F3" fuse (internal batteries).
- Switch on unit.

A device malfunction is generated.

- Adjust settings (as written down), time, and date on the unit.

Setting the clock will generate a new device ID (see also "Error when updating from SW 1.00 to 1.10" under chapter "Repair Information/Error Events").

- Switch device off and on again.

The unit should not generate any device malfunction. Settings recently made should be available. The operating hours should have the same status as before replacement of the EEPROM. Should O2 alarms be generated, you need to calibrate O2 sensor 2 manually (see also "Instructions for Use" manual). Previously detected options must be activated as described below.

- If "options" are lost during repair, write down the device ID and serial number and send them to the product management of the BU Intensive Care:

Lars Hansen Fax: (++49) 451/882 4089 Phone: (++49) 451/882 3492 E-mail: lars.hansen@draeger.com	Stefan Mixa Fax: (++49) 451/882 4089 Phone: (++49) 451/882 4798 E-mail: stefan.mixa@draeger.com
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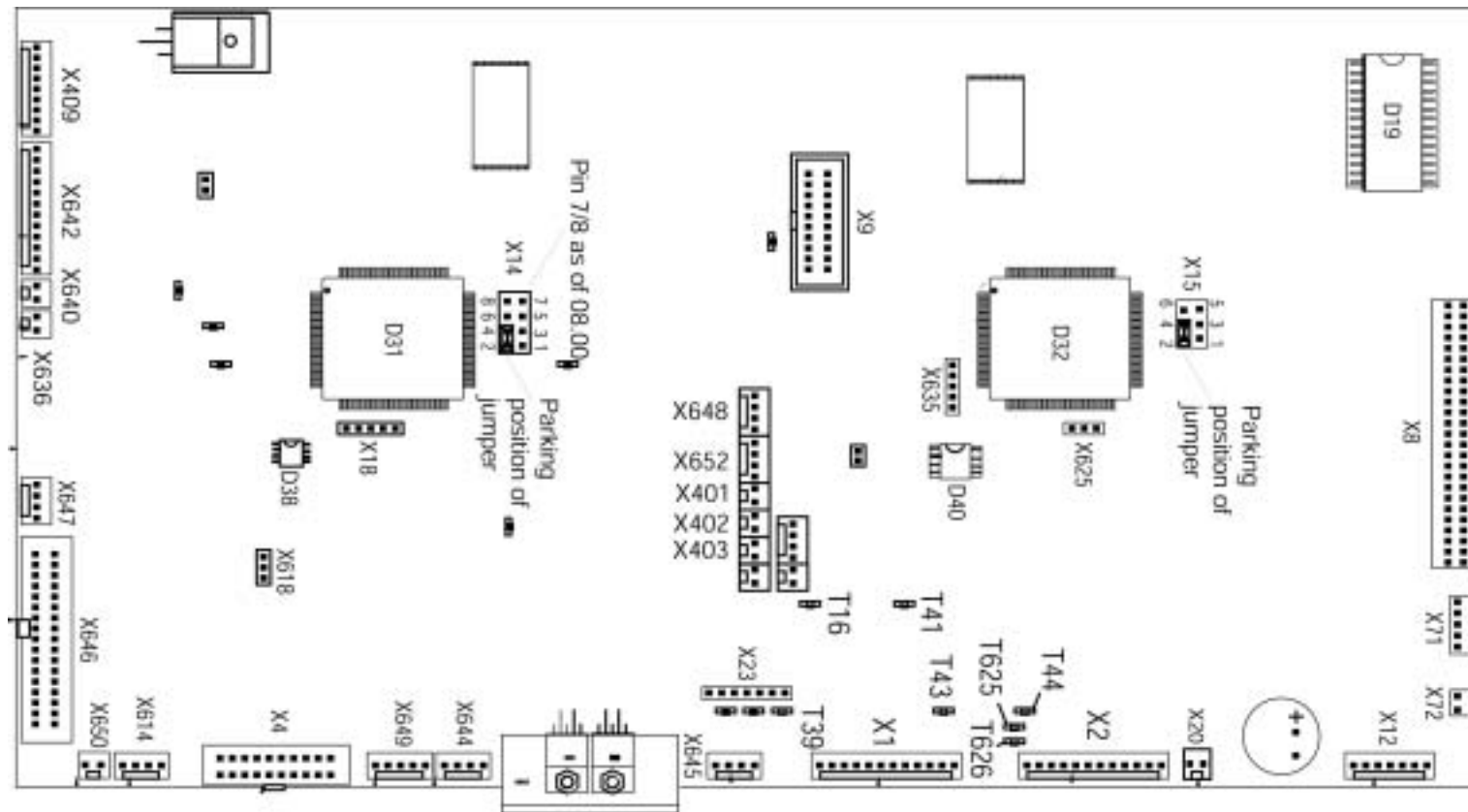
Please send me the release codes for the following options:

If the release codes are available, activate "BIPAP" and "Autoflow" options by entering the release codes in the fourth page of the "Config" menu.

- Switch device off and on again.
- Check whether options available before replacement of EEPROM here exist.
- Perform the safety check and functional check as per the Test Certificate.

## Control PCB

### General Information About the Control PCB



**Fig.52** View of the Control PCB

## Replacing the Control PCB

Read the following information before replacing the Control PCB:



**Remove EEPROM and RTC from old Control PCB and install on new Control PCB.**

**If SW version 1.00 is installed on the unit, update it to SW version 1.01 or higher after replacement (see also "Error when updating from SW 1.00 to 1.10" and "Download" under chapter "Repair Information/Error Events"). Otherwise the LEDs (at the front) could "flicker".**

**After replacement, re-enter all settings and carry out all necessary calibrations.**

**The unit must be off when replacing the Control PCB, and the battery fuse (fuse on rear panel of the unit) must be removed.**

**Memorize the connector pin assignment of the Control PCB.**

- Switch off the device.
- Open the device, see [Opening the operator control panel](#).
- Write down the connector pin assignment (see also "Control PCB" under "Schematics and Diagrams").
- Remove the Control PCB.

- Remove EEPROM and RTC from old Control PCB and install on new Control PCB. **(Note: all options will be lost if the EEPROM is not installed on the new Control PCB!).**
- Mount the new Control PCB.
- Assemble the unit.
- Insert the "F3" fuse (internal batteries).
- Download the software **(Note: it is recommended that you install the latest software version in compliance with country-specific approvals!).**



The following tests and calibrations must be carried out in DrägerService mode.

- Start DrägerService mode "Test 15".
- Compare calibration classes, bypass and expiratory valves with the labels on the rear panel, and reset data in "test step 5" if necessary.
- Start DrägerService mode "Test 22".
- Remove O2 sensor 1 and O2 sensor 2.
- Perform an offset calibration of the oxygen sensors in "test step 22".
- Fit O2 sensor 1 and O2 sensor 2.

- Start DrägerService mode "Test 27".
- Calibrate the absolute pressure sensors in "test step 27".
- Use an external pressure gauge to measure the current ambient pressure, and enter the value in the "set ambient pressure" menu item.
- Open DrägerService mode, "test step 3", and carry out menu item "Reset service hours".
- **Applies only to Savina with software version 2.10 or higher:**
  - Start DrägerService mode "test step 30".
  - Carry out an offset calibration of the internal battery's voltage.  
Conditions:
    - the offset calibration must be carried with a fully charged internal battery (reference voltage >23 V)
    - all external power supplies, including mains power supply, must be disconnected
    - adjust the voltage named "Set Offset" so that the deviation between the "Reference Voltage" and "Corrected Voltage" is as low as possible (maximum permissible tolerance is 150 mV)
- Exit DrägerService Mode.



The following tests and calibrations must be carried out in operating mode.

- Press the "Config" key.

- Select page 1/4 and check contrast and sound volume, adjust if necessary.
- Select page 2/4 and carry out a manual O2 calibration.
- Select page 3/4 and check language, time and date, adjust if necessary.
- Perform "electrical safety" and "function" tests as described in the PMS procedure.



## Pressure measuring unit

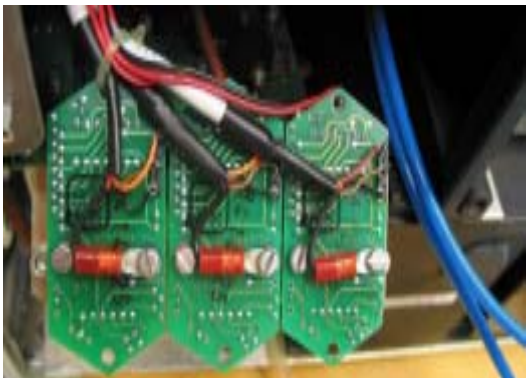

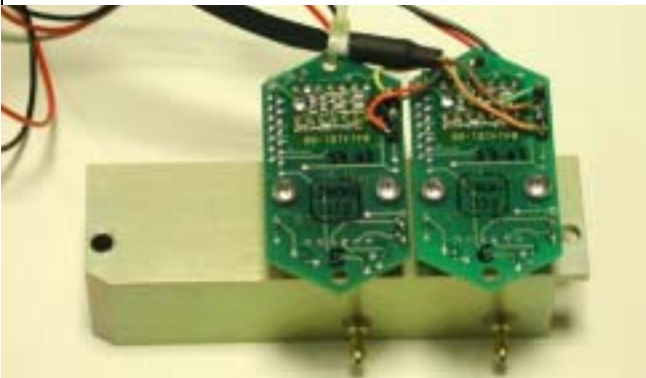
- General information about the pressure measuring unit
- Testing the pressure sensors
- Replacing the pressure sensor

### General information about the pressure measuring unit

The pressure measuring unit is available in several versions.



The pressure measuring units listed below are not interchangeable!

First version	Second version	Third version
		
<ul style="list-style-type: none"> <li>- Pressure sensor with ground connection</li> <li>- each pressure sensor has its own connecting cable</li> </ul>	<ul style="list-style-type: none"> <li>- Pressure sensor with ground connection</li> <li>- each pressure sensor has its own connecting cable</li> </ul>	<ul style="list-style-type: none"> <li>- Pressure sensor without ground connection</li> <li>- Pressure sensors have a common connecting cable</li> </ul>

## Information about the versions

### First version:

The first batch of approx. 100 devices has been manufactured with the first version of the pressure sensors. The third pressure sensor at the far left is electrically and pneumatically connected, but has not function in the device.

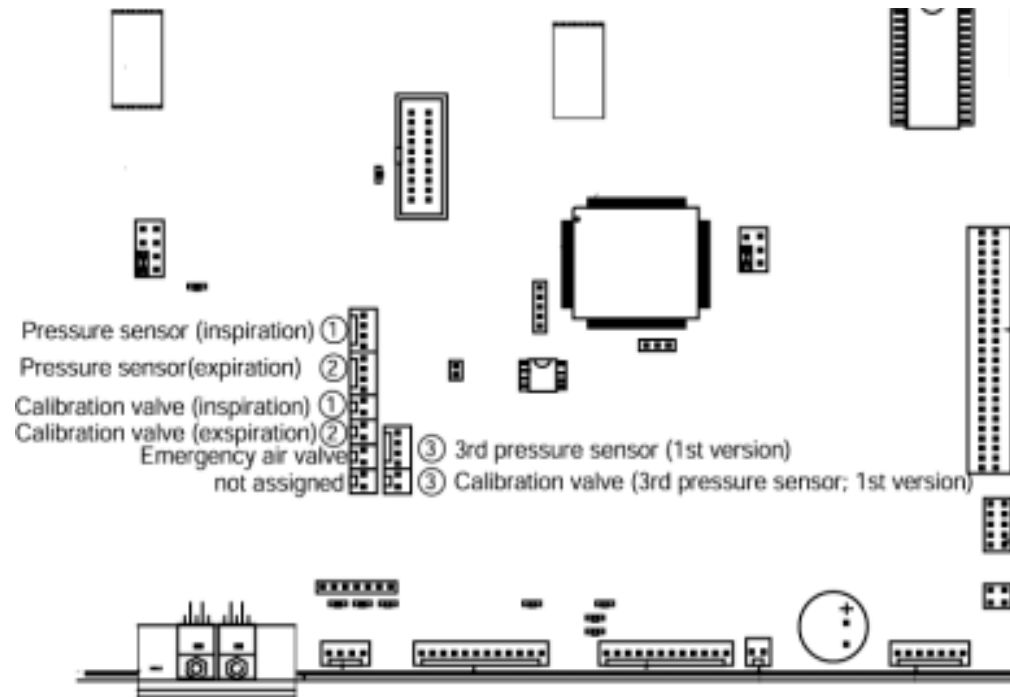
### First and second version:

The pressure sensors of the first and second version are identical.

### Third version:

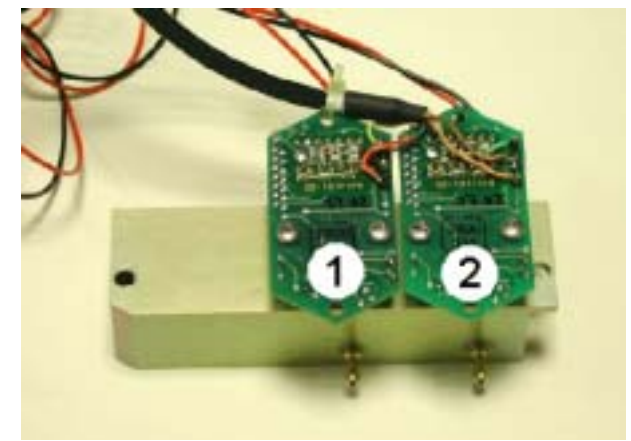
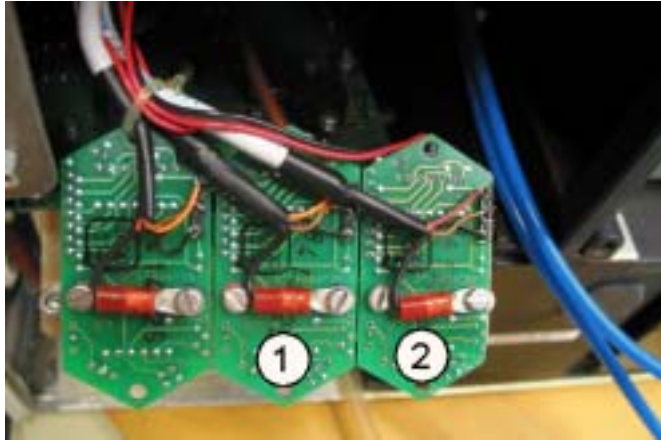
New pressure sensors have been installed in the devices since the first quarter of 2003. They are not compatible with the first and second version. Refer to the spare parts list!

## Connecting the pressure sensors and calibration valves



**Fig.53** Detail of the Control PCB; connecting pressure sensors

The "inspiratory" pressure sensor (see Fig. [Pressure measuring unit/1](#)) and the "expiratory" pressure sensor (see Fig. [Pressure measuring unit/2](#)) are mounted on the pressure measuring unit.



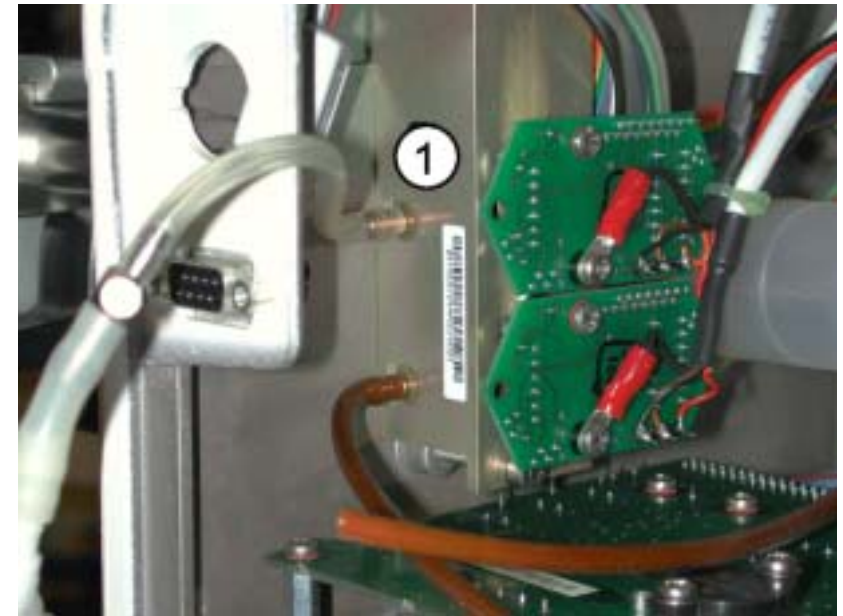
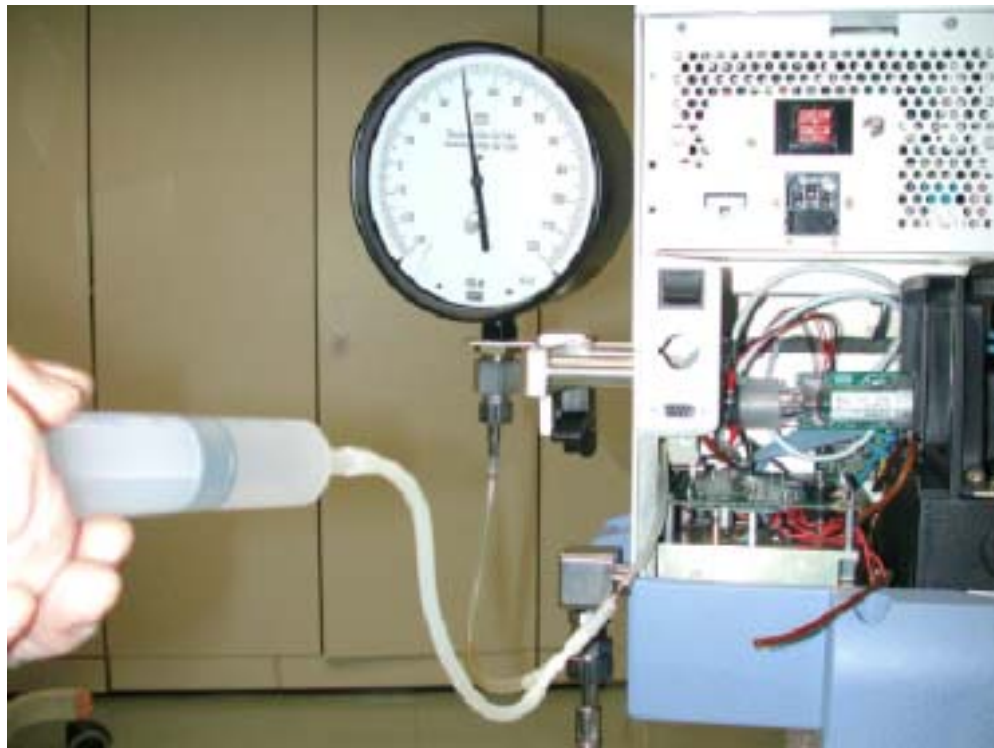
**Fig.54** Pressure measuring unit

## Testing the pressure sensors

The following example describes the "inspiratory" pressure sensor test. (Note: in order to test the "expiratory" pressure sensor, the test hose must be connected to the expiratory connector of the pressure measuring unit!).

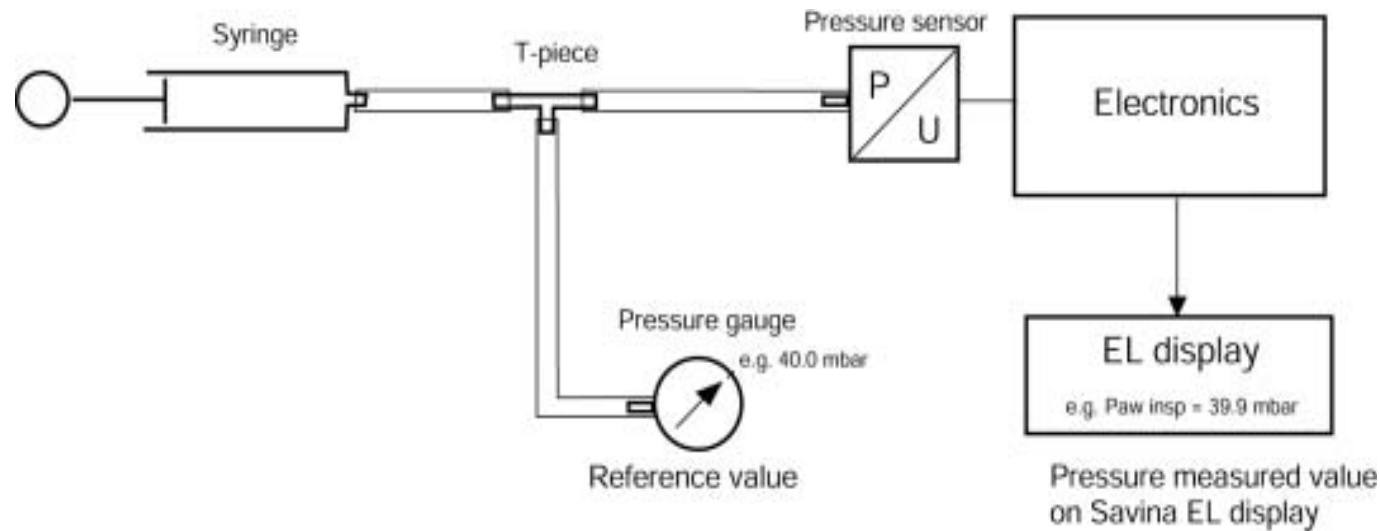
1. Switch off the device.
2. Take power plug out of mains socket.
3. Pull the fuse "F3" out of its holder on the rear panel of the device.
4. Open the device, see [Opening the operator control panel](#).
5. Disconnect the silicone, which leads to the inspiratory socket of the pressure measuring unit, from the pressure measuring unit.

6. Prepare the following test set-up using a syringe, 7901541, a pressure gauge (measuring range -30 to 120 mbar), 7910722, a Y-piece (plastic), 2M12754, and a reducer for log devices, M22286.
7. Connect the silicone hose to the inspiratory socket of the pressure measuring unit (Fig. [Left, test set-up](#); [right, connection to the pressure measuring unit/1](#)).



**Fig.55** Left, test set-up; right, connection to the pressure measuring unit





**Fig.56** Block diagram of the test set-up

8. Insert the fuse "F3" into its holder.
9. Plug the mains plug into the socket outlet.
10. Switch the device to DrägerService mode.
11. Open "test step 23" (menu "Calibrate insp. and exp. airway pressure sensors").
12. Carry out offset "Paw insp. sensor" and offset "Paw exp. sensor".



13. Start DrägerService mode "Test 12".
14. Using the syringe, generate the following pressures in sequence: 20 mbar, 40 mbar, 60 mbar, 80 mbar, and 100 mbar (Note: read each generated pressure at the external pressure gauge and compare them with the values shown on the display).

The display shows the pressure levels with a tolerance of +/- 2 mbar (Note: read the "Paw insp" value on the display!).



**Fig.57** Pressure values shown on the display

15. As soon as the "100 mbar" pressure is reached, switch "Insp. cal valve" to "ON".

The "inspiratory" pressure sensor vents to 0 mbar +/-1 mbar (ambient pressure).



**Fig.58** Display (venting of the pressure sensor)

16. Switch off the device.

17. Take power plug out of mains socket.

18. Pull the fuse "F3" out of its holder.

19. Remove the test set-up.

20. Reconnect the previously disconnected silicone hose of the device to the inspiratory socket of the pressure measuring unit.
21. Secure the rear panel to the device.
22. Secure the filter frame to the device.
23. Plug the power plug of the device into the socket-outlet.
24. Switch on unit.
25. Carry out an electrical safety test as per PMS procedure. For the USA and Canada: test according to CAN/CSA-22.2 No. 601.1-M90.
26. Carry out functional tests as per Instructions for Use manual.

## Replacing the pressure sensor

1. Switch off the device.
2. Take power plug out of mains socket.
3. Pull the fuse "F3" out of its holder on the rear panel of the device.
4. Open the device, see [Opening the operator control panel](#).
5. Remove the screws and washers (Fig. [Pressure measuring unit/1](#)) and place the pressure measuring unit into the device.



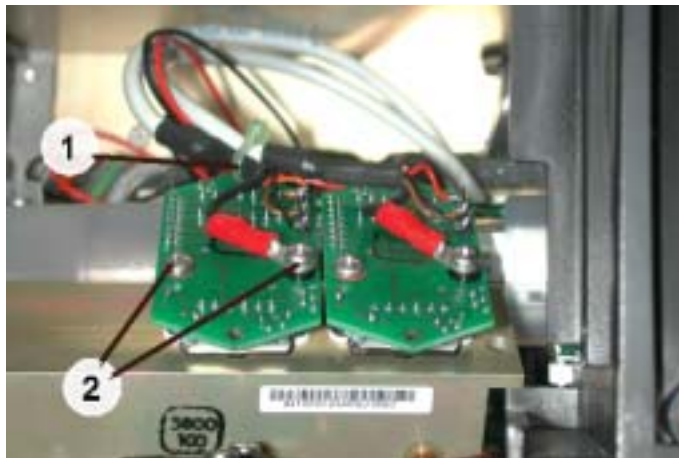
**Fig.59** Pressure measuring unit

6. Make a note of the colors of the cables that are connected to the faulty pressure sensor, then unsolder the cables from the connectors of the faulty pressure sensor.



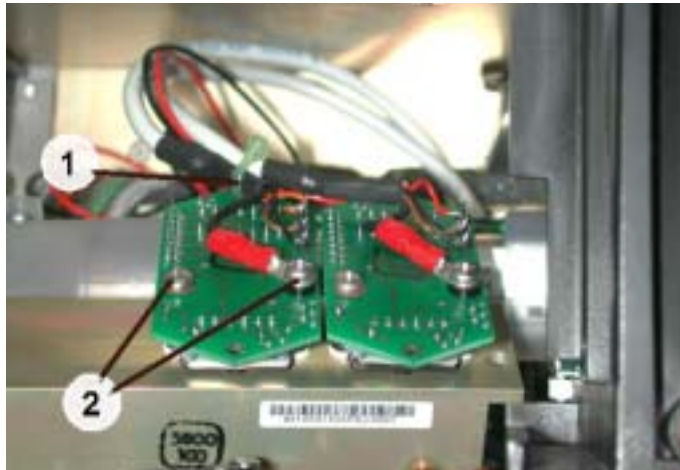
The following steps describe how to replace the "inspiratory" pressure sensor. Replacement of the "expiratory" pressure sensor is almost identical. **Make sure to order the correct version of the pressure sensor!**

7. Carefully cut the cable tie (Fig. [Example: faulty pressure sensor \(inspiratory\)/1](#)) on the pressure sensor making sure not to damage the cable.
8. Remove screws and washers (Fig. [Example: faulty pressure sensor \(inspiratory\)/2](#)) of the faulty pressure sensors.



**Fig.60** Example: faulty pressure sensor (inspiratory)

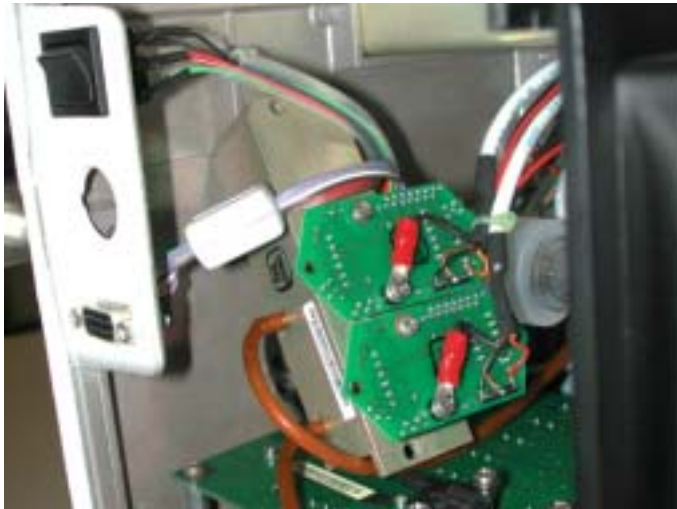
9. Remove the faulty pressure sensor and make sure that both sealings are still on the pressure measuring unit after removing the faulty pressure sensor.
10. Secure the new pressure sensor and both sealings to the pressure measuring unit using the screws and washers (Fig. [Example; pressure sensor \(inspiratory\)/2](#)) (Note: with pressure sensors of the "first" and "second" versions, also attach the ground wire).
11. Attach the cables to the hole on the new pressure sensor (inspiratory) using a cable tie (Fig. [Example; pressure sensor \(inspiratory\)/1](#)).



**Fig.61** Example; pressure sensor (inspiratory)

12. Cut off any protruding length of cable tie.

13. Solder the cables to the connections of the new pressure sensor according to the color coding recorded in a previous step.
14. Check that the hoses to the pressure measuring unit are undamaged and are connected securely to the connectors.
15. Push the pressure measuring unit under the cable of the power switch and the RS232 interface.



**Fig.62** Installation of cables

16. Secure the pressure measuring unit to the device using the screws and washers (Fig. [Fitting the pressure measuring unit/1](#)).



**Fig.63** Fitting the pressure measuring unit

17. Check the pressure sensor (inspiratory) or the pressure sensor (expiratory), see [Testing the pressure sensors](#).
18. Assemble the device.
19. Carry out an electrical safety test as per PMS procedure. For the USA and Canada: test according to CAN/CSA-22.2 No. 601.1-M90.
20. Carry out functional tests as per Instructions for Use manual.



## Internal battery

### General

The internal battery can be used to bridge a short power gap, e.g. when transporting a patient. When the device is powered from the internal battery, the following messages/alarms are generated until the internal battery is discharged:

- Int. battery activated
- Int. battery low
- Int. battery almost empty

If, after the message "Int. battery almost empty" is displayed, the device is operated until it fails (residual time), lower-priority alarms (e.g., "!! Tidal volume low") might be concealed.

If the batteries are completely discharged by operation of the device until it fails, recharge the batteries as fast as possible by connecting the device to an AC outlet or to a DC on-board electrical system.

## **Savina with software version 2.10 or higher**

Savina with software version 2.10 or higher has an improved charging management:

- additional capacity indication of internal battery by a battery symbol on the display (Note: the battery symbol is only visible if the internal battery is activated.)
- energy saving mode, i.e. the blower's rotation speed is reduced during operation with internal battery
- improved alarm concept (the device generates an audible/visual alarm if the capacity of the internal battery decreases below 30%, 20%, and 10%)

## **Operating time of the Savina with internal battery**

The total running time of the device, comprising the operating time and the residual time, is up to one hour. The operating time of the device is the time from the "Int. battery activated" message until the "Int. battery almost empty" alarm. The residual time is the remaining running time until the device fails.

The total running time of approximately one hour can be reached under the following conditions:

- the internal battery is fully charged (at least 6 hours of charging time) and has been in the device for no longer than two years
- the internal battery has not been damaged by a complete discharge or by the use of an external charging device
- operation at room temperature
- Adjust the following parameters on the Savina:
  - IPPV
  - VT = 700 mL
  - f = 12
  - PEEP = 5 mbar
  - Ti = 2 s
  - FiO2 = 60%
  - FlowAcc = 30 mbar/s
- Use the Dräger test lung 84 03 201 for testing  
(using another type of test lung, for example, the Siemens test lung, can result in a shorter running time)



**Approximately 80% of the energy are required for the operation of the blower. Especially by increasing the parameters FlowAcc, PInsp, and VT up to the maximum capacity of the Savina will reduce the operating time with the internal battery to less than 30 minutes.**

## **Internal battery care and possible damage**

### **Leave the device always connected to an AC power source**

To ensure a maximum internal battery capacity, we recommend leaving the device connected to an AC power source even when the device is not in use. The microprocessor controlled charging management then makes sure that the internal battery is always charged optimally. There is no risk of overcharging the internal battery.

### **How to avoid complete discharge**

The O<sub>2</sub> sample cells need a continuous current of 2-3 mA in order to maintain their measurement ability. This current can be interrupted by removing the fuse for the internal battery (on back of the device).

Spontaneous discharge of the internal battery is in the range of 1 mA. This current consumption cannot be avoided.

**As a rule, always store a Savina with its internal battery fully charged.**

For storage times longer than two (2) weeks, always remove the fuse for the internal battery (on back of the device).

After a complete discharge, the internal battery needs to be recharged. Completely discharged internal batteries that are stored over a longer period of time will suffer damage.

If an internal battery is completely discharged several times, it could be irreversibly damaged and, if that is the case, it can no longer be recharged by the Savina.